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Herpetofauna of the Maninjau caldera, West Sumatra, Indonesia, with special account to geckos

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ABSTRACT

The field surveys were conducted in the Maninjau Lake region, Sumatera Barat, Indonesia, in February 2020, mainly on the north-eastern slope of the Maninjau caldera at 450–600 m a.s.l. The slopes of the Maninjau caldera are naturally covered by a tropical rainforest that remains quite undisturbed from an altitude of 900 m up to the crater ridge. Natural vegetation of the northern and eastern slopes at altitudes from 450 and 500 to 600 m a.s.l. is replaced by rice plantations or mixed forest gardens. The typical habitat consisted of an evergreen broad-leaved forest on the slopes along a mountain creek and around a waterfall. Herein, we report 11 new species records for the Maninjau caldera; 9 new species records for Agam Regency; 3 new species records for Sumatra and Indonesia and 1 species of *Cnemaspis* Strauch, 1887 new for science. The morphology of rare and poorly known species of the bent toed gecko, *Cyrtodactylus agamensis* (Bleeker, 1860) is described for the first time. A high diversity of *Cyrtodactylus* Gray, 1827 occurs in Indochina and on the Thai-Malay Peninsula (150 species) but only six species in Sumatra. The Malay-Indochinese genus *Cnemaspis* has a recent spurt of diversity and now reaches eight species in Sumatra and only one species reaches Java. Current gecko diversity in Sumatra comprises 29 species in eight genera. The level of endemism level in geckos is very high and reaches 48%. The herpetofauna of Maninjau Caldera includes 26 amphibian and 46 reptile species. The faunistic core of the West Sumatran herpetofauna consists of Malay-Sundaic, Sumatran endemic, Sunda-Indochinese and widely distributed Oriental elements. The West Sumatran herpetofauna is characterized by the presence of a mutual species with Indochina, Malaysia, east India, Myanmar, the Andaman and Nicobar islands and Sri Lanka, often with disjunction in the huge territory of Indochina; species with continuous distribution from the Indian subcontinent to Papua and Oceania; and generalist species with wide pan-Indopacific distribution.

Key words: Amphibia, biodiversity, *Cnemaspis calderana* sp. nov., *Cyrtodactylus agamensis*, herpetofauna, Indonesia, Maninjau, Reptilia, Western Sumatra

Герпетофауна кальдеры Манинжау (Западная Суматра, Индонезия) с новыми данными по гекконам

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РЕЗЮМЕ

Полевые исследования на берегах озера Манинжау, расположенного в кратере потухшего вулкана в провинции Западная Суматра в Индонезии, проводились в феврале 2020 г. на высотах 450–600 м н.у.м. Склоны кальдеры Манинжау изначально были покрыты дождевым тропическим лесом, который остался нетронутым только на высотах от 900 м н.у.м. Естественная растительность на северном и восточном склонах на высотах от 450 до 500–600 м н.у.м. замещена рисовыми плантациями или садовыми посадками. Нами зарегистрировано 12 видов земноводных и 11 видов пресмыкающихся, из них – 11 новых видов для фауны Манинжау, 12 – для округа Агам, 3 – для фауны Суматры и Индонезии, а также новый вид гекконов рода *Cnemaspis* Strauch, 1887. Впервые приводится расширенное описание редкого, известного ранее только по голотипу, вида голопалых гекконов *Cyrtodactylus agamensis* (Bleeker, 1860). Высокий уровень разнообразия гекконов рода *Cyrtodactylus* Gray, 1827 характерен для Индокитая и Малайского полуострова (150 видов), в то время как на Суматре известно лишь 6 видов. Обширный малайско-индокитайский род *Cnemaspis* представлен на Суматре 8 видами, только один вид встречается на Яве. На сегодняшний день разнообразие гекконов Суматры составляет 8 родов и 12 видов. Уровень эндемизма у гекконов очень высок и составляет 48%. Полный список герпетофауны кальдеры Манинжау включает 26 видов земноводных и 46 видов пресмыкающихся. Из них – 11 суматранских эндемиков. Ядро западно-суматранской герпетофауны составляют сунда-малайские виды, суматранские эндемики, сунда-индокитайские и широко распространенные ориентальные виды. Для герпетофауны Западной Суматры характерно присутствие общих видов с Индокитаем, Малайзией, Восточной Индией, Бирмой, Андаманскими и Никобарскими островами, при этом в последних случаях часто – с дизъюнкцией на обширной территории Индокитая. Также присутствуют виды со сплошным ареалом от Индии до Папуа и Океании и виды – генералисты с циркумтропическим распространением в Старом Свете.

Ключевые слова: Amphibia, биоразнообразие, *Cnemaspis calderana* sp. nov., *Cyrtodactylus agamensis*, герпетофауна, Индонезия, Манинжау, Reptilia, Западная Суматра

INTRODUCTION

The Maninjau caldera is a volcano-tectonic depression with a wall that reaches an altitude of 1200–1400 m a.s.l., or 459 m from the surface of the lake, which has a maximum depth of 157 m. The predominant landscape around the lake consists of steep volcanic slopes formed by andesite rocks. The lake lies at an altitude of 450 m, and the crater ridges reach 1200 to 1500 m a.s.l. The average temperature remains almost constant throughout the year at about 25°C at the lake level. The slopes of the Maninjau caldera are naturally covered by a tropical rainforest that remains quite undisturbed from an altitude of 900 m up to the crater ridge. A mountain forest covers the slopes above 800 m a.s.l. Natural vegetation of the northern and eastern slopes at altitudes from between 450 and 500 to 600 m a.s.l. is replaced by rice plantations or mixed forest gardens (Michon et al. 1986; Harahap and Abedin 2006).

Herpetological investigations were first performed in this area in the middle of 19th century by P. Bleeker (1860a) who described Lüdeking's collections of amphibians and reptiles from West Sumatra. C.W.A. Lüdeking in 1860 provided two herpetolog-

ical collections containing 22 species from Agam Regency and 18 species from Fort de Kock (Bukittinggi). A full list of species of Agam was published by P. Bleeker and contained 6 amphibian and 26 reptile species including 8 new reptile species (Bleeker 1860a, 1860b; Lüdeking 1860). The most important were the descriptions of such currently valid species as *Lophyrus megalepis*, *Calotes Lüdekingi*, *Hemiphylodactylus typus*, *Gymnodactylus agamensis*, *Chelomeles sumatrensis*, *Tropidolepisma macrurus* and *Typhlina leucurus*. The bow-fingered gecko, *Cyrtodactylus agamensis* (Bleeker, 1860) is still known only from the single female type specimen (Rösler et al. 2007).

The next herpetological review of the Maninjau caldera in Agam Regency appeared only 150 years later. Teynié et al. (2010) published herpetological results of their field trip in 1998–1999 to West Sumatra, where the authors listed 15 amphibian species including 1 new species of toad and 27 reptile species in the Maninjau Lake region.

Thus, according to the last revision, the herpetofauna of the Maninjau caldera included 61 species: 18 amphibian and 43 reptile species (Bleeker 1860b; Teynié et al. 2010).

MATERIAL AND METHODS

Our field surveys were conducted in the Maninjau Lake region, Sumatera Barat, Indonesia, between the settlements of Matur, Maninjau, Bayur, Muko Muko and Lubuk Basung (Fig. 1) during the period 22 to 26 February 2020, mainly on the northeastern slope of the Maninjau caldera at 450–600 m a.s.l. (Fig. 2). The typical habitat consisted of an evergreen broad-leaved forest on the slopes along a mountain creek and around a waterfall (0°17'08.3"S 100°14'07.1"E). Surveys took place mainly during nighttime along forest paths and streams. Some diurnal species were recorded during daytime excursions along the lake coast, rice plantations and settlements. The animals were photographed in the field and subsequently released, or collected for further study.

Measurements and description of geckos follow those of Grismer et al. (2012, 2014). Measurements were taken with a slide-calliper to the nearest 0.1 mm. The following measurements were taken with a digital caliper to the nearest 0.1 mm on the left or left/right side of the body where appropriate: snout-vent length (*SVL*); tail length (*TL*); tail width (*TW*); forearm length (*FL*); tibia length (*TBL*); axilla to groin length (*AG*); head length (*HL*); head width (*HW*); head depth (*HD*); eye diameter (*ED*); eye to ear distance (*EE*); eye to snout distance (*ES*); eye to nostril distance (*EN*); ear length (*EL*); and internarial distance (*IN*). The following additional character states were also evaluated: the numbers of supralabial and infralabial scales (left/right side); the texture of the scales on the anterior margin of the forearm; the number of tubercles in paravertebral and lateral rows; the general size and arrangement of the dorsal body tubercles; the number of subdigital lamellae beneath the 1st and 4th toes counted from the base of the 1st phalanx to the claw; the distribution of transverse and granular subdigital lamellae on the 4th toe; the total number of femoro-precloacal pores; the degree and arrangement of body and tail tuberculation; the relative size and morphology of the subcaudal scales, subtibial scales, and submetatarsal scales beneath the first metatarsal; and the number of postcloacal tubercles on each side of the tail base; the number of dark body bands between the nuchal loop and the caudal constriction; the ratio of the width of the dark body bands divided by the width of the interspace between the bands; the number of dark caudal bands on the original tail; the presence

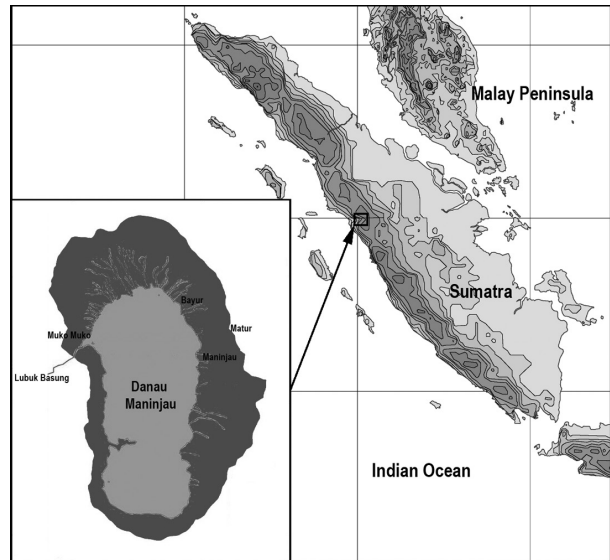


Fig. 1. Map of Maninjau caldera located in the Western Sumatra, Indonesia.



Fig. 2. Maninjau forests: a, Maninjau caldera forested slopes; b, small stream in the evergreen forest.

or absence of dark pigmentation infused in the white caudal bands of adults.

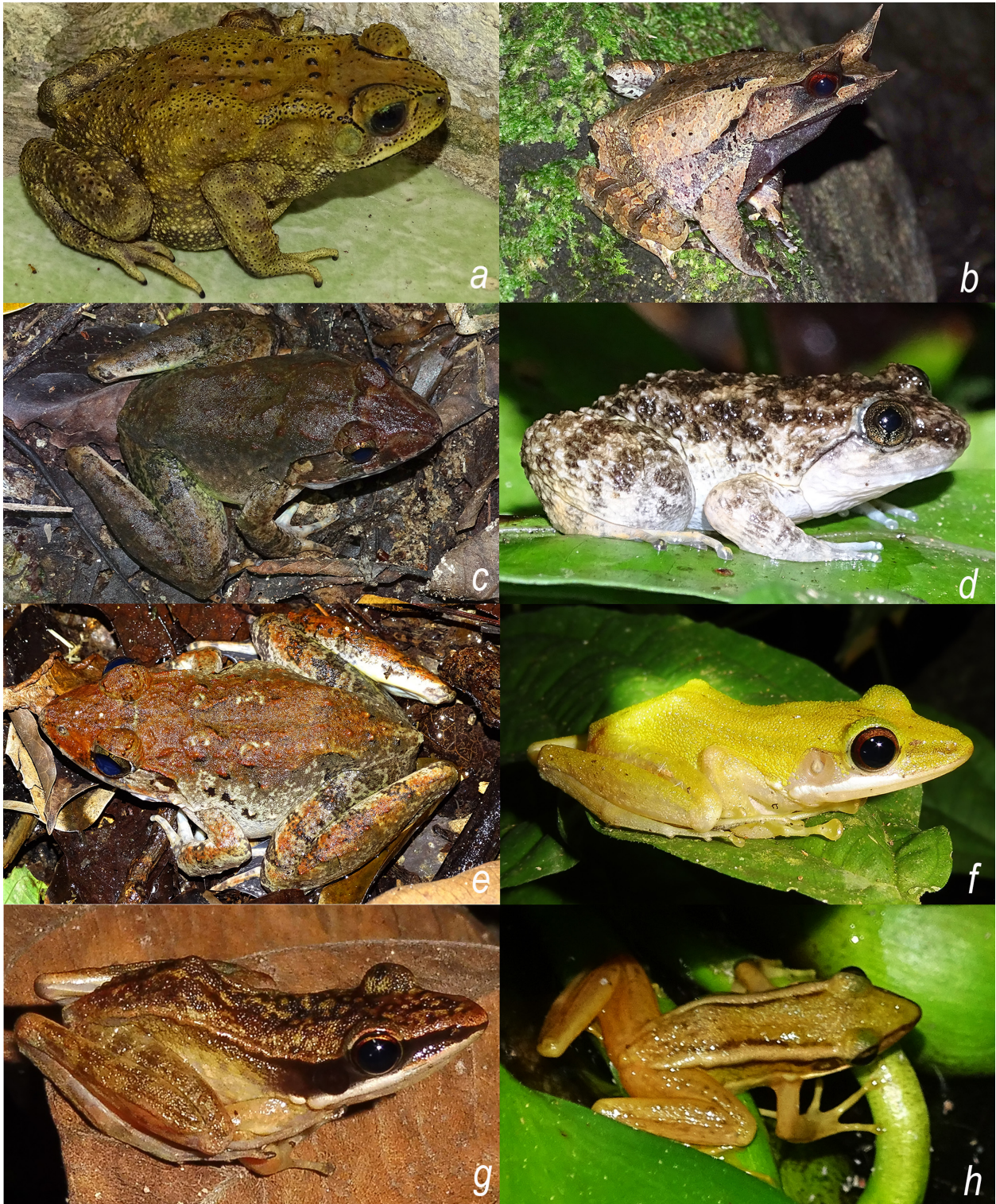


Fig. 3. Frogs and toads from Maninjau: a, *Duttaphrynus melanostictus*; b, *Megophrys nasuta*; c, *Limnonectes blythii*; d, *Limnonectes deinodon*; e, *Limnonectes shompenorum*; f, *Chalcorana parvaecola*; g, *Indosylvirana nicobariensis*; h, *Hylarana erythraea*.



Fig. 4. Frogs and lizards from Maninjau: a, *Odorrana hosii*; b, *Sumaterana crassiovis*; c, *Theloderma licin*; d, *Aphaniotis acutirostris*; e–h, *Cyrtodactylus agamensis*.

RESULTS

During our short-term field observations, we registered 12 amphibian and 11 reptile species in the Maninjau caldera (Figs 3–5). Herein, we provide 11 new species records for the Maninjau caldera (*Megophrys nasuta* (Schlegel, 1858), *Limnonectes blythii* (Boulenger, 1920), *Limnonectes deinodon* Dehling, 2014, *Chalcorana parvaccola* (Inger et al., 2009), *Indosylvirana nicobariensis* (Stoliczka, 1870), *Odorrana hosii* (Boulenger, 1891), *Sumaterana crassiovis* (Boulenger, 1920), *Theloderma licin* McLeod et Ahmad, 2007, *Cnemaspis calderana* sp. nov., *Sphenomorphus scotophilus* (Boulenger, 1900), *Trimeresurus sabahi* Regenass et Kramer, 1981); 9 new species records for Agam Regency (*M. nasuta*, *L. deinodon*, *C. parvaccola*, *I. nicobariensis*, *O. hosii*, *S. crassiovis*, *T. licin*, *C. calderana* sp. nov., *S. scotophilus*); 3 new species records for Sumatra and Indonesia (*L. deinodon*, *C. calderana* sp. nov., *S. scotophilus*) and 1 species of *Cnemaspis* Strauch, 1887 new for science. We also describe here for the first time the morphology of the rare and poorly known species of bent toed gecko, *C. agamensis*. These specific localities and voucher data are crucial for understanding the biodiversity of equatorial forest ecosystems in Western Sumatra. We also provide novel natural history information for selected species, including rare and recently described ones.

LIST OF SPECIES

Bufonidae

Duttaphrynus melanostictus (Schneider, 1799) – widespread Indo-Sundaic species, common in human-disturbed and cultivated areas. Observed in Maninjau near the lake coast.

Megophryidae

Megophrys nasuta (Schlegel, 1858) – Malay-Sundaic species, common in mountainous areas of Sumatra; male and female specimens found at night on the stones along the stream below the waterfall. First record for Maninjau and Agam.

Dicroglossidae

Fejervarya limnocharis (Gravenhorst, 1829) – abundant Southeast Asian species widely distributed from the Nicobar Islands and Myanmar throughout Indochina to the Greater Sundas. Common in an-

thropogenic habitats. Recorded in rice fields on the lake terraces in Maninjau.

Limnonectes blythii (Boulenger, 1920) – widely distributed from Myanmar to Sumatra and Borneo (Inger 1966; Manthey and Grossmann 1997). Numerous males and females were observed in large numbers in the nighttime along the stream and on the path bordering the stream in the forest. First record for Maninjau.

Limnonectes deinodon Dehling, 2014 – this recently described species from Malaysia has often been misidentified as the closely related *L. khasianus* (Dehling 2014; Hui et al. 2020). Recorded in some numbers during night excursions along the forest stream. All frogs were observed on large leaves of plants (*Zingiberaceae*) growing along the stream. This is the first documented record for Sumatra.

Limnonectes shompenorum Das, 1996 – was described from the Nicobar Islands and reaches Western Sumatra (Inger and Iskandar 2005; Kurniati 2008; Harikrishnan and Vasudevan 2018). It is probable that the previous record (Teynié et al. 2010) is actually a misidentified *L. blythii*. We found several males and females in the stream and near the waterline during the nighttime excursions.

Ranidae

Chalcorana parvaccola (Inger et al., 2009) – Sumatran endemic and common species in the forested areas of Western Sumatra. Recorded in some numbers on plant leaves along the forest stream. First record for Maninjau and Agam.

Indosylvirana nicobariensis (Stoliczka, 1870) – widely distributed species from the Nicobar Islands to Indonesia and the Malay Peninsula (Manthey and Grossmann 1997; Inger and Iskandar 2005; Kurniati 2008; Harmoko et al. 2020). One specimen was recorded on the forest floor near the stream. First record for Maninjau and Agam.

Hylarana erythraea (Schlegel, 1837) – this Indo-Sundaic species, widely distributed in Sumatra, is currently documented from the western and southern parts of the island (Bleeker 1860a, 1860b; Inger and Iskandar 2005; Kurniati 2008; Harmoko et al. 2020) and also from the east coast according one historical record from Tasik Sorei in 1907 (ZISP 14489–14414). We found several subadult specimens among *Pontederia crassipes* thickets on the lake coast.

Odorrana hosii (Boulenger, 1891) – this species with a Malay-Indonesian distribution is recorded by

us for the first time in Maninjau and Agam Regency. Males and females were recorded at night on near-shore vegetation and large stones along the stream.

***Sumaterana crassiovis* (Boulenger, 1920)** – Sumatran endemic species distributed throughout all mountainous Sumatra (Arifin et al. 2018). Frogs were recorded in large numbers on the plants along the forest stream. First record for Maninjau and Agam.

Rhacophoridae

***Theلودerma licin* McLeod et Ahmad, 2007** – currently known from the Malay Peninsula, Borneo and Western Sumatra (McLeod and Ahmad 2007; Kurniati 2008; Frost 2021). One specimen was found on leaves during a nighttime excursion on a forest path. First record for Maninjau and Agam.

Agamidae

***Aphaniotis acutirostris* Modigliani, 1889** – Sundaic species, widely distributed in the forested areas of Sumatra (De Rooij 1915; Manthey and Grossmann 1997; Kurniati 2008; Riyanto 2010; Tapley and Muurmans 2011; Teynié et al. 2010; Nugraha et al. 2020). Two females and one juvenile recorded on ferns near a waterfall.

Gekkonidae

***Cyrtodactylus agamensis* (Bleeker, 1860)** – was described from Agam based on single female specimen. Six specimens, 2 males and 4 females, were collected in Maninjau in February 2020. On the basis of this new material, we here present an extended description of this little-known species.

Holotype. BMNH 1946.9.7.44, female, Agam, Sumatra, E.W.A. Lüdeking, 1859.

Diagnosis. Adult males reaching 74.9 mm *SVL*, adult females reaching 86.8 mm *SVL*; 10–13 supralabials, 9–12 infralabials; tubercles of dorsum moderate in size with no intervening smaller tubercles; tubercles on ventral surfaces of forelimbs, in gular region absent, tubercles present in ventrolateral body fold; 31–37 paravertebral tubercles; 17–21 longitudinal rows of dorsal tubercles; 50–67 rows of ventral scales; 21–26 subdigital lamellae on 4th toe; 9–10 femoro-precloacal pores in males; dorsum not bearing a scattered pattern of white tubercles; 6–7 dark body bands with uneven margins often broken into separate spots; 10–12 dark, caudal bands on original tail; white caudal bands in adults infused with dark pigment (Table 1).

Coloration in life. Dorsal ground color of head, body, limbs, and tail beige-gray; nape with 5 irregular blotches; narrow, dark brown nuchal band extends from posterior margin of one eye to posterior margin of other eye, forms broken V-shaped figure on neck; 2nd neck band separated into 2 bands; 6 or 7 narrow, dark colored dorsal bands between limb insertions with uneven edges and often broken into 2 blotches; 1st band terminates at shoulders, last band terminates on sacrum; 5 or 6 dark gray ragged and poorly distinguishable bands on forelimbs and hind limbs; 10 to 12 wide, dark bands approximately twice the width of white bands extend onto tail; all bands encircle tail; ventral surfaces of head, limbs, and tail white; gular scales and abdomen immaculate, white.

Comparisons. *Cyrtodactylus agamensis* is distinguished from all Sumatran congeners by a high number of ventral scales and a low number of femorocloacal pores with the exception of *C. quadrivirgatus* Taylor, 1962. It is separated from *C. lateralis* (Werner, 1896) in having banded body coloration, 9–10 vs. 13 femorocloacal pores and having 10–12 vs. 7–9 caudal bands. It differs from *C. marmoratus* Gray, 1831 in having 9–10 vs. 15–26 femorocloacal pores and 50–67 vs. 40–50 ventral scales and by a banded dorsal pattern. It is further separated from *C. psarops* Harvey et al., 2015 in having 9–10 vs. 28–32 femorocloacal pores, 50–67 vs. 38–49 ventral scale and 17–21 vs. 23–26 rows of body tubercles. It is further separated from *C. quadrivirgatus* in having 50–67 vs. 34–42 ventral scales, in having 21–26 vs. 19–20 subdigital lamellae under the 4th toe and in lacking a striped dorsal pattern. *Cyrtodactylus agamensis* differs from most closely distributed and possibly parapatric species *C. semicinctus* Harvey et al., 2015 (Table 2) by a lower number of rows of body tubercles (17–21 vs. 24–27), a higher number of ventral scales (50–67 vs. 33–44), and a fewer number of femorocloacal pores in males (9–10 vs. 36–38) and in females (0–7 vs. 17–19).

Distribution. *Cyrtodactylus agamensis* is distributed in Maninjau caldera and Bukittinggi in Agam Regency, Western Sumatra, Indonesia (Bleeker 1860a, 1860b; our data).

Natural History. *Cyrtodactylus agamensis* is nocturnal species inhabiting humid mountain slopes covered by a tropical forest at an elevation of 600 m a.s.l. In total 14 specimens were encountered on the boulders and mossy rocky slopes along a small stream during nighttime excursions during the period



Fig. 5. Lizards and snakes from Maninjau: a, eggs of *Cyrtodactylus agamensis*; b, *Hemidactylus frenatus*; c, *Hemidactylus platyurus*; d, *Gekko monarchus*; e, *Sphenomorphus scotophilus*; f, *Varanus salvator*; g, *Trimeresurus sabahi*; h, *Tropidolaemus wagleri*.

Table 1. Measurements, indexes, scale counts and color pattern of the specimens of *Cyrtodactylus agamensis* from the type territory.

	BMNH 1946.9.7.44	ZISP 31457	ZISP 31458	ZISP 31459	ZISP 31460	ZISP 31461	ZISP 31462
Sex	Female	Female	Female	Female	Female	Male	Male
Snout-vent length (<i>SVL</i>)	49.7	50.6	86.8	82.8	74.5	74.9	62.2
Tail length (<i>TL</i>)	–	59.9	110	87	92.6	90.8	79.3
Tail width (<i>TW</i>)	–	3.1	6.2	5.1	4.4	4.6	3.9
Forearm length (<i>FL</i>)	–	7.5	13.2	13.0	11.3	11.7	9.8
Tibia length (<i>TBL</i>)	–	9.2	16.0	15.5	13.7	14.7	11.4
Axilla to groin length (<i>AG</i>)	–	22.2	40.9	36.9	34.1	32.6	26.1
Head length (<i>HL</i>)	13.4	15.4	26.1	24.5	22.5	22.8	18.5
Head width (<i>HW</i>)	8.3	8.9	14.6	13.7	13.9	13.5	10.8
Head depth (<i>HD</i>)	5.2	5.8	9.2	8.6	8.0	8.3	6.9
<i>AG/SVL</i>	–	0.44	0.47	0.45	0.46	0.44	0.42
<i>SVL/HL</i>	3.71	3.29	3.33	3.38	3.31	3.29	3.36
<i>HL/SVL</i>	0.27	0.30	0.30	0.30	0.30	0.30	0.30
<i>HL/HW</i>	1.61	1.73	1.79	1.79	1.62	1.69	1.71
<i>HW/HL</i>	0.62	0.58	0.56	0.56	0.62	0.59	0.58
<i>HL/HD</i>	2.58	2.66	2.84	2.85	2.81	2.75	2.68
<i>HD/HW</i>	0.63	0.65	0.63	0.63	0.58	0.61	0.64
<i>TL/SVL</i>	–	1.18	1.27	1.05	1.24	1.21	1.21
<i>ES/EE</i>	1.37	1.43	1.58	1.44	1.39	1.47	1.68
<i>EN/ES</i>	–	0.77	0.74	0.73	0.73	0.74	0.78
<i>ES/HL</i>	0.45	0.39	0.43	0.37	0.38	0.39	0.43
<i>TL/SVL</i>	–	1.18	1.27	1.05	1.24	1.21	1.27
<i>IN/HW</i>	–	0.20	0.18	0.16	0.13	0.13	1.17
<i>IO/HW</i>	–	0.22	0.46	0.42	0.23	0.27	0.22
<i>ED/HL</i>	–	0.25	0.22	0.21	0.22	0.23	0.24
<i>EE/HL</i>	0.33	0.27	0.27	0.26	0.27	0.26	0.25
Eye diameter (<i>ED</i>)	–	3.8	5.8	5.2	5.0	5.2	4.5
Eye to ear distance (<i>EE</i>)	4.4	4.2	7.1	6.3	6.1	6.0	4.7
Eye to snout distance (<i>ES</i>)	6.0	6.0	11.2	9.1	8.5	8.8	7.9
Eye to nostril distance (<i>EN</i>)	–	4.6	8.3	6.8	6.2	6.5	6.2
Inner orbital distance (<i>IO</i>)	–	2.0	6.7	5.8	3.2	3.7	2.4

23–25 February. A clutch containing 10 eggs was observed on a vertical rock under the forest canopy on 23 February.

***Cnemaspis calderana* sp. nov.**, a new Sumatran endemic species from Maninjau caldera.

Holotype. ZISP 31463, adult female, Maninjau caldera, Agam Regency, Sumatera Barat, Sumatra, Indonesia, 600 m a.s.l., 23 February 2020.

Etymology. The specific epithet *calderana* is a feminine adjective meaning belonging to a vast circus-shaped basin of volcanic origin, in reference to the distribution of this species being restricted to the Maninjau caldera.

Diagnosis. Maximum *SVL* 42.9 mm; 10 supralabials; 8–9 infralabials; smooth ventral scales; 28 paravertebral tubercles; tubercles linearly arranged, present on flanks; ventrolateral caudal tubercles absent; lateral caudal row present; caudal tubercles not encircling tail; 4 postcloacal tubercles; no enlarged femoral or subtibial scales; enlarged submetatarsal scales on 1st toe; 14 subdigital 4th toe lamellae; dorsally with irregular transverse dark blotches and pale vertebral stripe; tail with 12 broad dark transverse bands.

Description of holotype. Adult female (Figs 6, 7); *SVL* 42.9 mm; *AG* 20.3; *HL* 11.4 mm; *HW* 6.8 mm; *HD* 4.4 mm; head oblong in dorsal profile, moderate

	BMNH 1946.9.7.44	ZISP 31457	ZISP 31458	ZISP 31459	ZISP 31460	ZISP 31461	ZISP 31462
Ear length (<i>EL</i>)	–	0.9	1.5	1.7	1.5	1.6	1.0/1.2
Internarial distance (<i>IN</i>)	–	1.8	2.6	2.2	1.8	2.0	1.8
Supralabials	11/12	11/10	13/12	10/12	11/12	11/11	13/12
Infralabials	10/11	10/10	10/12	9/9	11/10	10/10	11/11
Internasals	2	4	4	4	4	4	5
Tubercles on the anterior dorsal and ventral margins of the forearm	dorsal	dorsal	? dorsal	dorsal	dorsal	dorsal	dorsal
Tubercles on the hindlimbs	dorsal	dorsal and anterior	dorsal and anterior	dorsal	dorsal	dorsal	dorsal
paravertebral tubercles	–	35	31	32	36	37	33
Longitudinal rows of body tubercles	19	17	19	21	19	19	19
Tubercles in the gular region	–	no	no	no	no	no	no
Tubercles in the throat	–	no	no	no	no	no	no
Tubercles in the lateral margins of the abdomen	–	yes	yes	yes	yes	yes	yes
Longitudinal rows of ventral scales	67	50	65	67	60	66	67
Tubercles on lateral fold	36/30	45/42	24/22	22/18	28/28	34/31	25/27
1th toe lamellae	17/17	15/15	16/15	16/15	6/6	–/13	18/17
4th toe lamellae	26/26	22/21	22/24	24/23	21/21	21/21	24/24
Femoro–precloacal pores	0	1	5	6	7	10	9
Postanal tubercles	1/1	0	0	0	1/2	2/2	2/2
Degree and arrangement of body tuberculation	–	moderate	moderate	moderate	moderate	moderate	moderate
Relative size and morphology of the subcaudal scales	–	large, smooth	large, smooth	large, smooth	large, smooth	large, smooth	large, smooth
Number of dark body bands	7	7	6	7	6	6	7
Ratio of the width of the dark body bands	dark < light	dark < light	dark < light	dark < light	dark < light	dark < light	dark < light
Number of dark caudal bands on the original tail	–	11	10	11	10	12	10
Presence or absence of dark pigmentation infused in the white caudal bands	–	present	present	present	present	present	present

in size (HL/SVL 0.27), somewhat narrow (HW/SVL 0.16), flat (HD/HL 0.39), distinct from neck; snout short (ES/HL 0.45), slightly concave in lateral profile; ES 5.1 mm; IN 1.3 mm; postnasal region constricted medially, raised; scales of rostrum smooth, larger than similarly shaped scales on occiput; low, supraorbital ridges; moderate frontonasal sulcus; canthus rostralis rounded; eye large (ED/HL 0.20); ED 2.3 mm; pupil round; EE 3.4 mm; fringe scales small in general but largest anteriorly; pupil round; ear opening oval, taller than wide; rostral scale slightly concave, partially divided by medial groove, rostral bordered posteriorly by two supranasals, laterally by 1st

supralabials and nostrils; 10/10 supralabials decreasing gradually in size posteriorly; 8/9 infralabials, decreasing gradually in size posteriorly; nostrils small, slightly oblong, oriented dorsoposteriorly, bordered posteriorly by small, granular, postnasal scales; mental large, triangular, concave, bordered posteriorly by 2 postmentals; gular and throat scales raised, conical; body slender, elongate (AG/SVL 0.47); small, dorsal scales equal in size throughout body, intermixed with bluntly pointed tubercles more or less randomly arranged; tubercles extend from dorsum to flanks; number of tubercles in paravertebral row 28; number of tubercles in dorsolateral row 35; number of tubercles

Table 2. Morphological data of two *Cyrtodactylus* species with diagnostic characters (in bold) separating *C. agamensis* and *C. semicinctus*.

Characters	<i>Cyrtodactylus agamensis</i>		<i>Cyrtodactylus semicinctus</i>	
	Males	Females	Males	Females
SVL max	74.9	86.8	75	89
HL/SVL	0.30	0.27–0.30	0.27–0.30	0.25–0.29
TL/SVL	1.05–1.27		1.05–1.19	
HW/HL	0.59–0.58	0.56–0.62	0.62–0.71	0.59–0.72
IN/HW	0.13–0.20		0.17–0.21	
IO/HW	0.22–0.46		0.29–0.39	
ES/HL	0.39–0.45		0.37–0.45	
EN/ES	0.73–0.78		0.68–0.78	
ED/HL	0.21–0.25		0.21–0.27	
EE/HL	0.25–0.33		0.27–0.33	
Supralabials	10–13		10–15	
Infralabials	9–12		8–10	
Rows of body tubercles	17–21		24–27	
Ventrals	50–67		33–44	
1th toe lamellae	6–18		8–11	
4th toe lamellae	19–26		19–22	
Femoro-precloacal pores	9–10	0–7	36–38	17–19
Postanal tubercles	0–2		2–3	
Dark body bands	6–7		5–7	
Dark caudal bands on the original tail	10–12		9–11	

in lateral row 30; pectoral and abdominal scales smooth, roundish, not larger posteriorly; abdominal scales slightly larger than dorsals; no pore-bearing, precloacal scales or precloacal depression; forelimbs and hindlimbs moderately long, slender; *FL* 6.4 mm; *TL* 7.7 mm; dorsal scales feebly keeled; ventral scales of brachia smooth; scales beneath forearm smooth, imbricate; palmar scales smooth, juxtaposed; digits long with inflected joint; claws recurved; 14 (8+6) subdigital transverse lamellae on 4th toe divided by 3 granular scales; lamellae beneath 1st phalanges granular proximally, widened distally; lamellae beneath phalanx immediately following inflection granular, lamellae of distal phalanges wide; interdigital webbing absent; fingers increase in length from 1st to 4th with 4th and 5th equal in length; hind limbs slightly longer and thicker than forelimbs; dorsal scales raised, smooth or feebly keeled, juxtaposed; scales of anterior margin of thigh feebly keeled; ventral scales of thigh smooth; subtibial scales smooth, flat, imbricate, with no enlarged anterior row; plantar scales smooth, juxtaposed; no enlarged submetatarsal scales beneath 1st metatarsal; digits elongate

with inflected joint; claws recurved; subdigital lamellae unnotched; caudal scales arranged in segmented whorls; caudal scales smooth; moderate, single, lateral furrow; subcaudals smooth, no enlarged median row of scales; paravertebral row of tubercles on tail base, no other caudal tubercles; 4/4 postcloacal tubercles on lateral surface of postcloacal swellings at tail base; tail original with length 47.4 mm and width 2.3 mm.

Coloration in alcohol. Brownish dorsally with irregular transverse dark blotches and weakly distinct discontinuous pale vertebral stripe; whitish ventrally; tail with 12 broad dark transverse bands.

Comparisons. *Cnemaspis calderana* sp. nov. has numerous diagnostic scale and color pattern character states that separate it from all other Sumatran species. From all Mentawai Archipelago species group (*C. jacobsoni* Das, 2005, *C. dezwaani* Das, 2005, *C. modiglianii* Das, 2005, *C. whittorum* Das, 2005) it differs by a large body size (42.9 vs. 30.5–33.7) and a large number of supralabials (10 vs. 6–7). *Cnemaspis calderana* sp. nov. differs from *C. jacobsoni*, *C. modiglianii* and *C. whittorum* in having paravertebral rows of tubercles and smooth pectoral



Fig. 6. Holotype of *Cnemaspis calderana* (ZISP 31463).

and abdominal scales, from *C. dezwaani*, *C. modiglianii* and *C. whittenorum* by a low number of subdigital lamellae under the 4th toe (14 vs. 16–19) and in having smooth pectoral and abdominal scales. *Cnemaspis calderana* *sp. nov.* differs further from all Sumatra mainland members (*C. rajabasa* Amarasinghe et al., 2015, *C. aceh* Iskandar et al., 2017, *C. andalas* Iskandar et al., 2017, *C. minang* Iskandar et al., 2017, *C. pagai* Iskandar et al., 2017 and *C. tapanuli* Iskandar et al., 2017) in having smooth dorsal scales and a low number of subdigital lamellae under the 4th toe (14 vs. 18–34). From *C. rajabasa* the new species differs also by a large number of paravertebral tubercles (28 vs. 20–21), a low number of supralabial and infralabial scales (10 vs. 13–14 and 8 vs. 11–12), in

having smooth ventral and subcaudal scales, and in lacking tubercles encircling the tail; from *C. aceh* by a large body size (42.9 vs. 30.7), in lacking a keeled gular, pectoral, abdominal and subcaudal scales and in having a large number of supralabials (10 vs. 7); from *C. andalas* by a large number of supralabials and infralabials (10 vs. 6–7 and 8 vs. 7); from *C. minang* by a large body size (42.9 vs. 31.3), smooth gular scales, a large number of supralabials and infralabials (10 vs. 8 and 8 vs. 7) and in having a pale vertebral stripe; from *C. pagai* by smooth gular, pectoral, abdominal, subcaudal scales and ventral scales of thigh; from *C. tapanuli* by smooth gular and pectoral scales, and a large number of supralabials and infralabials (10 vs. 6 and 8 vs. 6).

Table 3. Checklist of the amphibian and reptile species from Maninjau caldera, Sumatera Barat, Indonesia discovered since 1860.

Species	Bleeker 1860	Teynié et al. 2010	Our data
<i>Ichthyophis paucisulcus</i>		+	
<i>Phrynooidis asper</i>		+	
<i>Duttaphrynus melanostictus</i>		+	+
<i>Duttaphrynus totol</i>		+	
<i>Megophrys nasuta</i>			+
<i>Microhyla berdmorei</i>		+	
<i>Microhyla heymonsi</i>	+	+	
<i>Kalophrynus pleurostigma</i>	+		
<i>Kaloula baleata</i>	+		
<i>Fejervarya cancrivora</i>		+	
<i>Fejervarya limnocharis</i>		+	+
<i>Hoplobatrachus rugulosus</i>	?		
<i>Limnonectes blythii</i>			+
<i>Limnonectes deinodon</i>			+
<i>Limnonectes shompenorum</i>		+	+
<i>Limnonectes</i> sp.		+	
<i>Chalcorana parvaccola</i>			+
<i>Chalcorana rufipes</i>	+	+	
<i>Indosylvirana nicobariensis</i>			+
<i>Huia sumatrana</i>		+	
<i>Hylarana erythraea</i>	+	+	+
<i>Odorrana hosii</i>			+
<i>Pulchrana glandulosa</i>		+	
<i>Sumaterana crassiovis</i>			+
<i>Polypedates leucomystax</i>		+	
<i>Theloderma lacin</i>			+
<i>Aphamotis acutirostris</i>		+	+
<i>Bronchocela cristatella</i>	+	+	
<i>Gonocephalus megalepis</i>	+		
<i>Lophocalotes ludekingi</i>	+		
<i>Dibamus leucurus</i>	+		
<i>Dibamus novaeguineae</i>	+		
<i>Gehyra mutilata</i>	+	+	
<i>Hemidactylus garnotii</i>	+		
<i>Hemidactylus frenatus</i>	+	+	+
<i>Hemidactylus platyurus</i>	+		+

Distribution. *Cnemaspis calderana* sp. nov. is known only from the type locality of Maninjau caldera, Agam Regency, Sumatera Barat, Sumatra, Indonesia.

Natural History. *Cnemaspis calderana* sp. nov. is nocturnal species inhabiting humid mountain slopes covered by tropical forest at an elevation of 600 m a.s.l. A total of 6 specimens including the holotype

were encountered on the boulders and rocky slopes along a small stream during nighttime excursions on 23 and 24 February.

***Hemidactylus frenatus* Dumeril et Bibron, 1836** – species with circumtropical distribution, originally around the Indian Ocean area. Common species in human habitats, found in Maninjau and Bayur.

Species	Bleeker 1860	Teynié et al. 2010	Our data
<i>Hemiphyllodactylus typus</i>	+		
<i>Cyrtodactylus agamensis</i>	+		+
<i>Ptychozoon horsfieldii</i>	+		
<i>Cnemaspis calderana</i> sp.nov.			+
<i>Gekko monarchus</i>		+	+
<i>Dasia olivacea</i>		+	
<i>Eutropis multifasciata</i>	+	+	+
<i>Larutia sumatrensis</i>	+		
<i>Lygosoma quadrupes</i>		+	
<i>Sphenomorphus scotophilus</i>			+
<i>Varanus salvator</i>		+	+
<i>Xenopeltis unicolor</i>	+	+	
<i>Malayopython reticulatus</i>		+	
<i>Brachyorrhos albus</i>	+		
<i>Calamaria schlegeli</i>	+		
<i>Ahaetulla prasina</i>	+	+	
<i>Boiga cynodon</i>		+	
<i>Boiga drapiezii</i>		+	
<i>Coelognathus flavolineatus</i>	+	+	
<i>Coelognathus radiatus</i>	+		
<i>Dendrelaphis caudolineatus</i>		+	
<i>Dendrelaphis pictus</i>	+	+	
<i>Lycodon subcinctus</i>	+		
<i>Ptyas carinatus</i>		+	
<i>Ptyas korros</i>		+	
<i>Sibynophis geminatus</i>		+	
<i>Pseudorabdion eiselti</i>		+	
<i>Rhabdophis chrysargos</i>	+		
<i>Xenochrophis trianguligerus</i>	+	+	
<i>Asthenodipsas laevis</i>		+	
<i>Xenodermus javanicus</i>		+	
<i>Calliophis bivirgatus</i>	+		
<i>Calliophis intestinalis</i>	+	+	
<i>Naja sumatrana</i>		+	
<i>Trimeresurus sabahi</i>	+		+
<i>Tropidolaemus wagleri</i>		+	+

***Hemidactylus platyurus* (Schneider, 1797)** – common Oriental synanthropic species. Recorded on buildings in Maninjau.

***Gekko monarchus* (Schlegel, 1836)** – common Indonesian species distributed from the Malay Peninsula to Papua New Guinea and throughout Sumatra. Juveniles recorded on the leaves of *Pontederia crassipes* in Maninjau while hunting small insects.

Scincidae

***Eutropis multifasciata* (Gray, 1845)** – widely distributed Oriental species, common in Sumatra. Recorded in Maninjau, Matur and Muko Muko in gardens, plantations and along the rice-fields.

***Sphenomorphus scotophilus* (Boulenger, 1900)** – this Malayan species has not previously been recorded in the islands of Indonesia (De Rooij 1915;

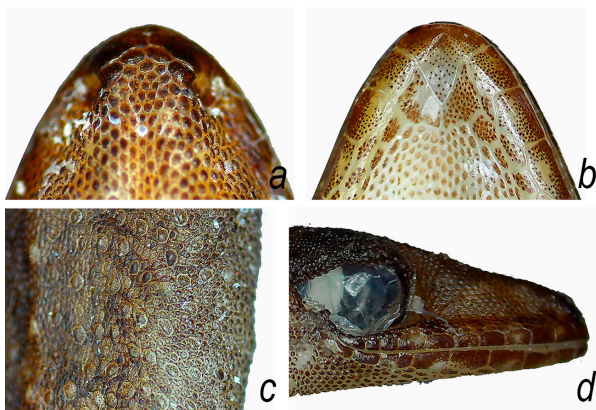


Fig. 7. Head and body of *Cnemaspis calderana*: a–b, snout and chin; c, granules on flank; d, head lateral view.

Manthey and Grossmann 1997). We found one juvenile on a tree trunk near a mountain stream under the forest canopy. Thus, the range of this species extends at least to Sumatra.

Varanidae

Varanus salvator (Laurenti, 1768) – common Sunda-Indian species distributed everywhere in Sumatra. Recorded by us in Maninjau on the lake-shore.

Viperidae

Trimeresurus sabahi Regenass et Kramer, 1981 – species with Malay-Indonesian distribution (Vogel et al. 2004; Mulcahy et al. 2017) and common in the forested areas of Sumatra. We recorded 4 specimens on the branches above the mountain stream during night excursions. Moreover, 3 individuals, 2 males and 1 female, were observed in one place for two nights and demonstrated sexual behavior. Copulation was registered on February 25. First species record for the Maninjau caldera.

Tropidolaemus wagleri (Boie, 1827) – Malay-Indonesian species described from Western Sumatra. One young male recorded near a forest path over three nights.

DISCUSSION

According to our recent field research and literature data the herpetofauna of Maninjau caldera currently includes 26 amphibian and 46 reptile species (Table 3). This species list is incomplete and does not reflect the high level of biodiversity in Western Sumatra. The relatively high level of species and even gener-

ic endemism is well known for Sumatra. Thus, 11 Sumatran endemic amphibian and reptile species have been recorded in the Maninjau caldera. Among them, 2 endemic gecko species (*C. calderana* sp. nov. and *C. agamensis*). The highest diversity of *Cyrtodactylus* occurs in Indochina and on the Thai-Malay Peninsula (150 species) whereas there are only 6 species in Sumatra. Nevertheless, 4 supraspecific complexes of bent toed geckoes including the *Cyrtodactylus agamensis* group (*C. agamensis*, *C. semicinctus* and *C. psarops*), *Cyrtodactylus lateralis* group (*C. lateralis*), *Cyrtodactylus sworderi* group (*C. quadrivirgatus*) and *Cyrtodactylus marmoratus* group (*C. marmoratus*) have been reported in Sumatra (Grismer et al. 2021). The presence of the first 3 species groups in Sumatra suggests that its fauna is closer to the Malayan. The similarity between the Malayan and Sumatran faunas is much greater than that of the Bornean or Javan fauna. The *Cyrtodactylus marmoratus* species group, on the contrary, has an eastern-Indonesian origin. The territory of Sumatra lies outside the bent toed gecko centers of diversity and, apparently, Sumatran fauna will not fundamentally increase in the future due to the description of new species. By contrast, the real diversity of *Cnemaspis* is underestimated and will increase significantly in the future. The Malay-Indochinese genus *Cnemaspis* had a recent spurt of diversity and reaches 8 species in Sumatra and only 1 species reaches Java. Recognized gecko diversity in Sumatra comprises by 29 species in 8 genera. The level of endemism is very high and reaches 48%.

The West Sumatran herpetofauna is extremely interesting, given its high biodiversity, high endemism rate, and the presence of a mutual species with Indochina, Malaysia, east India, Myanmar, the Andaman and Nicobar Islands and Sri Lanka (*F. limnocharis*, *Gehyra mutilata*, *Dasia olivacea*, *V. salvator*, *Coelognathus flavolineatus*, *Lycodon subcinctus*, *Xenochrophis trianguligerus*), often with a disjunction in the huge territory of Indochina (*L. shompenorum*, *I. nicobariensis*). Another distribution pattern is presented by species that occur from the Indian subcontinent in the west to Papua and Oceania in the east (*E. multifasciata*) and generalist species with wide pan-Indopacific distribution (*G. mutilata*, *H. frenatus*). The faunistic core of the West Sumatran herpetofauna consists of Malay-Sundaic (15 species in Maninjau), Sumatran endemic (11 species), Sunda-Indochinese (8 species) and widely distributed Oriental elements (8 species).

Despite its great scientific interest and the availability of a rather rich literature, the herpetofauna of Sumatra is still poorly known; up to now many species were known from a very limited number of specimens from a few localities. The lack of data of the biology and distribution of most of the species and on the systematics of some genera (*Limnonectes*, *Cnemaspis*, *Cyrtodactylus*, *Pseudorabdion*) results in a deficient understanding of the fauna composition. The aim of this paper was to fill one of these gaps by providing updated data on the amphibian and reptile distribution of the Maninjau caldera on the basis of recent field research.

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